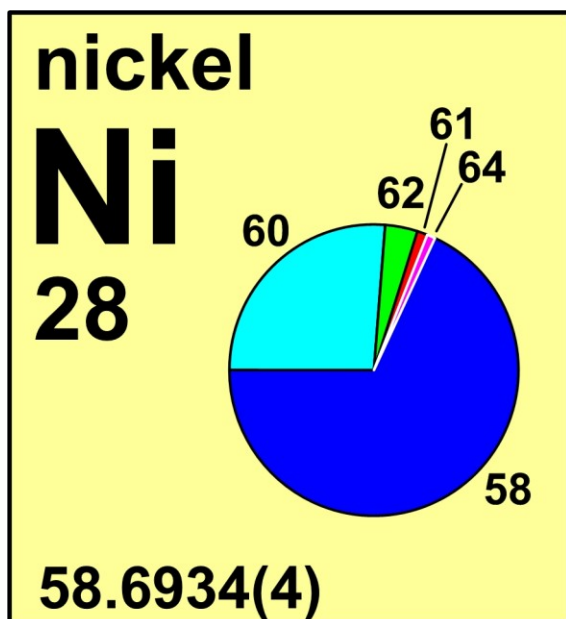
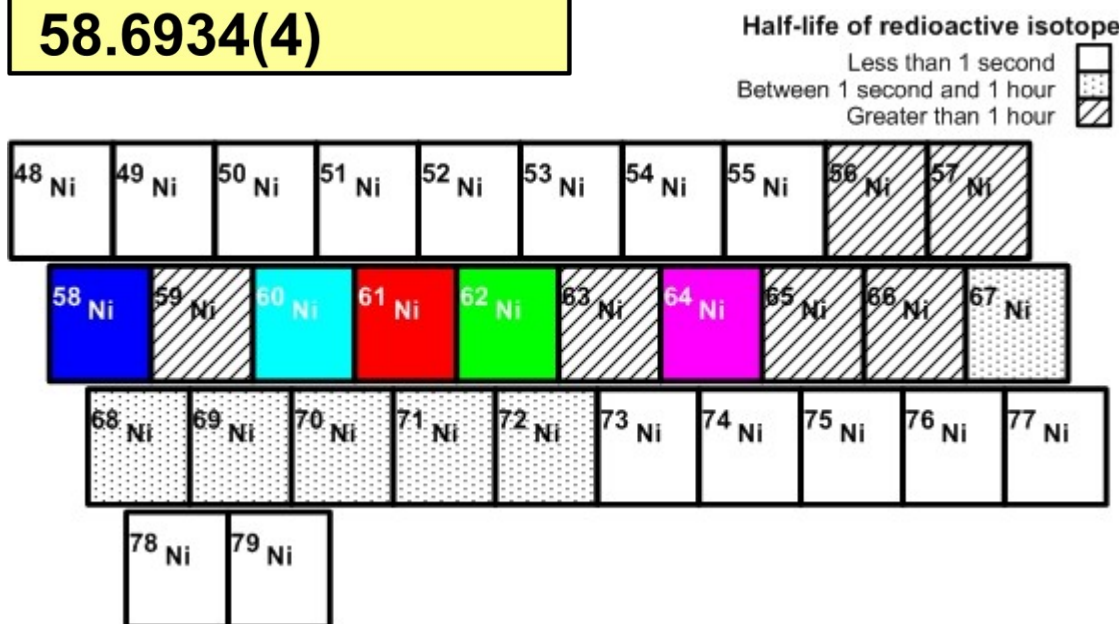


## nickel



Stable isotope	Atomic mass*	Mole fraction
<sup>58</sup> Ni	57.935 3429	0.680 769
<sup>60</sup> Ni	59.930 7864	0.262 231
<sup>61</sup> Ni	60.931 056	0.011 399
<sup>62</sup> Ni	61.928 3451	0.036 345
<sup>64</sup> Ni	63.927 966	0.009 256

\* Atomic mass given in unified atomic mass units, u.



## Important applications of stable and/or radioactive isotopes

### Isotopes in medicine

- 1) Stable isotopes of nickel are used as radiation targets to obtain radio-nuclides for nuclear medicine. This includes <sup>61</sup>Ni for production of the positron emitting radioisotope <sup>61</sup>Cu for PET applications and <sup>64</sup>Ni for production of <sup>64</sup>Cu, which is used in radio-immunotherapy by attaching it to an antibody for delivery of cytotoxic radiation to a target cell.

### Isotopes in tracer studies

- 1) Natural nickel enriched in one of its stable isotopes has been used for tracing absorption, excretion, distribution and utilization of Mg in higher organisms.
- 2) Isotopically enriched nickel can also be used to study nickel transfer processes in the biosphere, geosphere and hydrosphere as well as in isotope dilution mass spectrometry for quantitative analysis of nickel.
- 3) Nickel radioisotopes can also be used as tracers but potential health and environmental hazards limit the usefulness of nickel radioisotope for such applications.

### Isotopes in geology, hydrology or planetary sciences

- 1) Anomalies in  $^{60}\text{Ni}$  abundance caused by decay of nowadays extinct  $^{60}\text{Fe}$  have been used to study the early history of our solar system (see iron).
- 2)  $^{59}\text{Ni}$  is a long-lived cosmogenic radionuclide with a half-life of 76,000 years. Decay of  $^{59}\text{Ni}$  has been used to assess the terrestrial age of meteorites and to determine abundances of extraterrestrial dust in ice and sediment.
- 3) Small but measurable natural mass dependent variations in nickel isotope abundances have been suggested as markers for methane producing microbes in the Earth's early history.

### Isotopes in industrial applications and engineering

- 1)  $^{63}\text{Ni}$ , produced from stable  $^{62}\text{Ni}$ , is a beta emitting nuclide that serves as an electron source together with  $^{55}\text{Fe}$  in electron capture detectors. Electron capture detectors are used as thickness gauges or as detectors for organic analytes in gas chromatography.
- 2)  $^{63}\text{Ni}$  is also used as a fluorescence inducing source in elemental analysis by X-ray fluorescence spectroscopy and in miniaturized long-lived nuclear batteries. Until the mid-1980s nuclear batteries were used in pacemakers, they were replaced by long-lasting lithium batteries.
- 3)  $^{60}\text{Ni}$  is used for the production of  $^{57}\text{Co}$  which is used in densitometric measurements and as a reference source for gamma cameras as used in nuclear medicine.